Ergonomics
Mercedes Benz

Presented To:

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Specialization: 3rd Computer

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Preface

The Mercedes-Benz E-Class is a range of executive cars manufactured by Mercedes-Benz in various engine and body configurations. The E initially stood for *Einspritzmotor*, (German for fuel injection engine); a new feature in volume production vehicles at the time that the E-Class first appeared, with the E as a suffix to the engine nomenclature (e.g. 230E) in the 1950s. It was not until the launch of the face lifted W124 that the E was used as a prefix (i.e., E220) and the model referred to officially as the E-Class (or *E-Class*). At this time all Mercedes cars used fuel injection and the company felt it was not necessary to add this as a distinguishing feature. Due to the E-Class's size and durability, the cars also frequently serve as taxis in European countries. Older models like the W123 and W124 are used in Malaysia as inter-state taxis, and the W211 is used in Singapore as a taxi. Mercedes-Benz also offers special-purpose vehicles (e.g., police or ambulance modifications) from the factory.

Chapter 1

Historical view

1.1 Historic:

1.1.1 W120 'Panton'

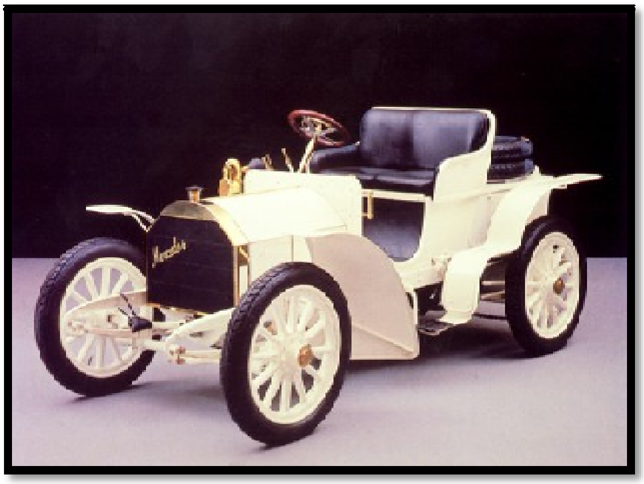

Figure (1.1)

The first modern mid size Mercedes was the W120 'Panton' 180 of 1953. Sharing its engineering with the R121 190 SL of 1955, the Panton was a stylish sedan with four-cylinder power. A larger-engine W121 190 appeared in 1958.

1.1.2 W110 'Fantails'

Figure (1.2)

Mercedes added tailfins to both the big S-Class and the new W110 'Fintail' 190 of 1962. Straight-6 power appeared for the first time in the 1965 230 model, and the fours grew in displacement that year as well.

1.1.3 W114/W115 'Stroke-8'

Figure (1.3)

The mid size Mercedes was redesigned in 1968 as the W114/W115 'Stroke-8'. This time, the 6-cylinder models (The W114s) were most prevalent, with the W115 line making up the bottom of the company's offerings with four – and five-cylinder power. Diesel engines joined the line-up, as did a coupé body.

1.1.4 W123

The popular W123 quickly became a best-seller on its launch in 1976. Especially in Diesel 240D (and later 300D) guises, the cars enhanced the company's reputation for product quality. Over 2.3 million were produced until the end of production in 1986.

Saloon/Sedan, Coupé and Estate body configurations were offered.

1.1.5 W124

W124

Production	**1984–1996**
Model years	**1985 – 1995**
Assembly	**Sindelfingen, Germany** **Bremen, Germany** **Rastatt, Germany (for the US-market)** **Zuffenhausen, Germany,** **Pune, India** **Toluca, Mexico**
Body style	**4-door sedan** **5-door station wagon** **2-door coupe** **2-door convertible**

Platform	**Mercedes-Benz W124**
Wheelbase	**Sedan & Wagon: 110.2 in (2,799 mm) Coupe: 106.9 in (2,715 mm)**
Length	**Wagon: 188.2 in (4,780 mm) Sedan: 187.2 in (4,755 mm) Coupe: 183.9 in (4,671 mm)**
Width	**68.5 in (1,740 mm) E500 Sedan: 70.7 in (1,796 mm)**
Height	**Wagon: 59.8 in (1,519 mm) Sedan: 56.3 in (1,430 mm) Coupe: 55.5 in (1,410 mm) Convertible: 54.8 in (1,392 mm) E500 Sedan: 55.4 in (1,407 mm)**
Curb weight	**3927 lb (500E) 3826 lb (400E)**

The 'E-Class' name first appeared in the USA with the face-lifted W124 for the model year 1994 (the w124 was introduced in the US in 1986 but continued with the older models' naming convention until 1993, when all Mercedes-Benz models switched to a new system, e.g., E320 instead of 300E). The 300D continued to be the fuel economy option over the 4 and 6 cylinder gasoline engines, and the gasoline V8 engines (available after 1992) increased gasoline power outputs further. The V8 powered sedans/saloons were named 400E/500E from 1992–1993, and E420/E500 after 1993. Likewise, the 3-liter cars (e.g., 'E300') where also re-badged to 'E320' with the new 3.2 litre engines and naming rationalization of 1994.

Saloon/Sedan, Coupé, Convertible and Estate body configurations were offered.

From 1992 to 1994 Mercedes offered a limited production sport version of the W124 sedan, created and assembled with help from Porsche. This was called the 500E (E500 for 1994).

1.1.6 W210

W210	
	
Production	**1995–2002**
Model years	**1996–2002**
Body style	**4-door sedan** **5-door station wagon**

The W210 E-Class, launched in 1996, brought the mid-size Mercedes firmly into the upper end of the luxury market. Though six-cylinder models were still offered for a time, the four-light front end and high prices moved the car upmarket. In September 1999 the W210 E-class was facelifted. This included visual, mechanical and quality improvements over the earlier versions.

The Mercedes-Benz E-Class was *Motor Trend*'s Import Car of the Year for 1996

Figure (1.4)

1.1.7 W211

W211	
	
Production	2002–2009
Model years	2003–2009
Assembly	Bremen, Germany Pune, India Beijing, China Cairo, Egypt Pekan, Malaysia Tehran, Iran Bogor, Indonesia
Body style	4-door sedan 5-door station wagon
Platform	Mercedes-Benz W211
Transmission	5-speed automatic 7-speed automatic6-speed manual

Launched in 2002, the W211 E-Class was another evolution of the previous model and was considered by the motoring media as an even more competitive offering to the long term rival BMW 5-Series (which previously was the preferred choice of the motoring media). Before North American sales began, the car was shown in the 2002 movie *Men in Black II*.

The W211-based W219 CLS-Class 4-door coupé was introduced as a niche model in 2005, primarily to attract a younger demographic.

The W211 E-Class was face lifted in 2007 to address quality and technical issues raised by earlier models, Sensotronic was dropped, while Pre-Safe (w/o brake support) was made standard. The largest factory built engine in the E-class range is the E500 (badged E550 in the U.S.) which had its engine size increased from 5 litres to 5.5 litres in 2006 along with the facelift. There is also an AMG model badged E63 AMG and other tuning house installations.

Mercedes-Benz introduced their BlueTec Diesel system to the E-Class at the 2006 North American International Auto Show as the E320 CDI BlueTec. BlueTec is a two-phase system for cleaning diesel emissions. The first phase makes the E320 CDI legal in 45 of the 50 United States (plus the District of Columbia). The second phase uses urea for further reductions to meet the more stringent standards of California, Maine, Massachusetts, New York, and Vermont. Sales of E320 CDI BlueTec began in autumn 2006 as a 2007 model, but 50-state legal models with urea injection will not be introduced until the 2009 model year.

<u>Figure (1.5)</u>

2009 Mercedes-Benz E350 (W211; US)

<u>Figure (1.6)</u>

Facelift E-Class W211

Figure (1.7)

Facelift E-Class W211

Mercedes-Benz W212	
	
Production	2009–present
Model years	2010–present
Assembly	Sindelfingen, Germany Pune, India Toluca, Mexico Cairo, Egypt Beijing, China
Class	Executive car
Body style	4-door sedan 5-door station wagon 2-door coupé convertible

Layout	**Front engine, rear-wheel drive / four-wheel drive**

The W212 replaced the W211 in 2009. Official photos of the W 212 were leaked on the internet on 9 December 2008 ahead of its 2009 Geneva Motor Show unveiling. Scans of a leaked brochure were posted onto the internet in January 2009, detailing the whole E-Class range including the new E 200 CGI and E 230 CGI with direct injected forced inducted engines. New features include a blind spot monitor, Lane Keeping Assist, Pre-safe with Attention Assist and Night View Assist Plus. In the United States the E-class will be priced nearly US$4,600 less than the previous model. The E-class coupe is built in Bremen using the W204 C-class platform. The W212 estate was also announced and goes on sale from November 2009. The W212 cabriolet was announced January 11, 2010 at the North American International Auto Show, for sale March 27, 2010 in Europe and in May 2010 in the United States.

Features on the 2010 version include folding mirrors when locked. Locking can be done on the touch sensors on every door handle and the lock button of the power closing trunk. The colors available for sedan are: Calcite White, Black, Cuprit Brown Metallic, Diamond White BRIGHT Metallic, Indium Grey Metallic, Iridium Silver Metallic, Obsidian Black, Palladium Silver Metallic, Pearl Beige Metallic, Tanzanite Blue Metallic and Tenorite Grey Metallic.

Figure (1.8)

Mercedes-Benz E 350 coupe (Australia)

Figure (1.9)

Mercedes-Benz E 350 4Matic sedan (US)

Figure (1.10)

Mercedes-Benz E 350 CDI

Avant-garde wagon (Germany)

1.1.8 E55 AMG

The previous AMG model of the E-Class was the W211 E55 with 469 hp (350 kW) and 516 lbf·ft (700Nm) between 2650 and 4500 rpm (the power band). A supercharger system was used to increase the power of the base engine of the E55 from 369 hp (275 kW) to 469 hp (350 kW). The E55 can accelerate from 0 to 60 mph (97 km/h) in 4.3 seconds and has a quarter-mile time of anywhere from the high 11's to low 12's depending on driver and each individual car. The difference between the E55 opposed to the newer naturally aspirated E63 is the potential of one to the E55. Since the E55 engine has a forced induction system (supercharger), this allows for smaller pulleys to be installed and tuned to gain more power. The major drawback to the E55 is the cooling system (mainly the stock Bosch intercooler pump does not have sufficient flow rate) which is highly prone to heat soaking after a series of high speed pulls. The solution to this common problem is replacing the stock intercooler pump with an aftermarket Johnson CM30 pump.

Prior to the W211 E55 was the W210 E55 model which has a naturally aspirated AMG-tuned powerplant. The M113 powered the W210 E55 which used a 5.4L V8 SOHC 24V to produce 354 PS (260 kW; 349 hp in US-spec) and 391 ft·lb (530 N·m) of torque. The body styling on all of the W210 AMG models was the same until 2000 when a facelift and numerous interior upgrades were implemented. The W210 E55 was the last vehicle that a major portion of production took place by hand at AMG in Affalterbach. Production was actually split between Affalterbach and the Bremen Mercedes-Benz facility until the end of 2001. The 2001 E55 AMG was a rare version of the W210 E55, of which only 659 units were produced in 2001. Various road tests revealed 0–60 mph in 4.5-5.8 seconds, (with a fresh ECU computer), and 5.5-8.0 seconds (with a bad ECU computer) and quarter-mile times of 13.3–13.5 seconds.

1.1.9 E63 AMG

The performance version of the E-Class, the E63 AMG is the first sedan built entirely by AMG. With a 518 hp (386 kW) engine, the E63 can achieve a top speed of around 200 mph (320 km/h) (electronic limiter off), and can accelerate from 0 to 60 mph (97 km/h) in 4.3 seconds.

The styling has been altered for both aesthetic and practical purposes: AMG side skirts and rear apron give the E63 more aggressive styling, and the larger air apertures on the front of the car allow for more air intake to the naturally aspirated 6.2 liter V8. Another styling change on the E63 is the wider, flared front wheel arches which accommodate the AMG front axle with a 2.2-inch-wider (56 mm) track.

For 2012, Mercedes-Benz started offering a bi-turbo V8 version. It has a W157, 5.5L twin-turbo V8, that is rated at 518 hp, which is mated to a 7-speed AMG Speedshift MCT transmission

Portland Speed Industries, a performance shop in Hillsboro, OR, have tested a 2012 E63 AMG biturbo on their Dynojet dynamometer and it produced 479 whp and 561 ft-lbs of torque.

Mercedes-Benz W212

Production	**2011–present**
Model years	**2012–present**
Assembly	**Sindelfingen, Germany Pune, India Toluca, Mexico Cairo, Egypt Beijing, China**
Class	**Executive car**
Body style	**4-door sedan 5-door station wagon 2-door coupé convertible**
Layout	**Front engine, rear-wheel drive / four-wheel drive**

Background

The CLS marked Mercedes-Benz's return to the executive-size coupe market since the (W124) E-Class Coupe (a two-door sedan) went out of production in 1995. The (W210) E-Class did not spawn a coupe variant, as Mercedes-Benz choose instead to introduce a smaller coupe based on the compact C-Class, the CLK-Class. However, the CLK-Class was built with a lengthened C-Class wheelbase so it could be slotted as a mid-sized vehicle, and it also featured styling cues, engines, and similar pricing to the (W210) E-Class to give the impression that the (W124) E-Class Coupe had been directly replaced.

Marketed as a four-door coupe, the CLS was designed by the American automotive designer, Michael Fink[2] (born 1967), who styled the first CLK, the C-Sportcoupe, and is known as the stylist who penned the Maybach 57 and 62. According to a Mercedes-Benz

press release, the CLS-class was produced to combine the "strong, emotive charisma" of a coupe with the "comfort and practicality" of a saloon. Save for its four-door design, the CLS's design tends towards a coupe, as its sleek roofline reduces the rear passenger room to a 2+2 arrangement, and it offers a smaller selection of engines tending towards high powered of the range, compared to contemporary sedans such as the E-Class.[3]

CLS W219 (2004–2012)

The first generation of the CLS, the Mercedes-Benz W219, was based upon the W219 platform, a W211 E-Class spin-off that is six inches (152 mm) longer. IVM Automotive, a subsidiary of German roof system specialist Edscha, developed the entire vehicle from the Vision concept to the production version. More than 150 IVM engineers were involved, making the CLS the largest vehicle development project in the company's history.[citation needed]

The CLS-class was first displayed as the Vision CLS concept at the 2003 Frankfurt International Motor Show. The production version CLS 500 made its debut at the 2004 New York International Auto Show. An AMG version was introduced at the 2004 Paris Motor Show, the CLS 55 AMG. Only 3,000 CLS 55 AMG cars were to be built each year.

On sale in Europe in 2004, the CLS was offered for sale in the United States in January 2005 as the CLS 500 and CLS 55 AMG. In 2006, Mercedes phased out both the 5.0L in the CLS 500 and 5.5L Supercharged V8 in the CLS 55 AMG in favor of two new 5.5L and 6.2L V8s. This resulted in the 2007 model year name change to the CLS 63 AMG (6.2L V8) and CLS 550 (5.5L V8) in the United States. The CLS 500 badge continues to be used in various markets with the 5.5L V8 motor.

Mercedes-Benz has planned a yearly production of 30,000 units worldwide, of which about 10,000 will be shipped to the U.S. market. The 2012 CLS 550 had a base price of US$72,175 in June 2011 (equivalent to £43905 today), with the CLS 55 starting at US$87,320. The 2012 CLS63 started at $96,775 (equivalent to £58869 today), for a base model, and is offered with steering wheel mounted paddles (F1 style), and 19" wheels for the US market. It was assembled by Daimler AG in Sindelfingen, Germany and Mercedes-Benz Mexico in Toluca, Mexico.

1.2 Specifications

	Engine	Power	Torque	0–100 km/h (62 mph)	Top speed
CLS 320 CDI	3.0 L diesel V6	165 kW (224 hp DIN)	510 N·m (380 ft·lbf)	7.0 seconds	250 km/h (155 mph)
CLS 320 CDI	3.0 L diesel V6	165 kW (224 hp DIN)	540 N·m (380 ft·lbf)	6.7 seconds	250 km/h (155 mph)
CLS 350 CDI	3.0 L diesel V6	165 kW (224 hp DIN)	540 N·m (380 ft·lbf)	7.0 seconds	250 km/h (155 mph)
CLS 350	3.5 L M272 V6	200 kW (272 hp DIN)	350 N·m (258 ft·lbf)	7.0 seconds	250 km/h (155 mph)
CLS 350 CGI	3.5 L M272 V6	215 kW (292 hp DIN)	365 N·m (269 ft·lbf)	6.7 seconds	250 km/h (155 mph)
CLS 500 (2006)	5.0 L M113 V8	228 kW (306 hp DIN)	460 N·m (339 ft·lbf)	6.1 seconds	250 km/h (155 mph)
CLS 550 CLS 500 (2007-)	5.5 L M273 V8	281 kW (388 hp DIN)	530 N·m (391 ft·lbf)	5.1 seconds	250 km/h (155 mph)
CLS 55 AMG (2006)	Supercharged 5.4 L AMG M113 V8	350 kW (493 hp DIN)	715 N·m (516 ft·lbf)	4.8 seconds	250 km/h (155 mph)
CLS 63 AMG	6.2 L AMG M156 V8	378 kW (514 hp DIN)	630 N·m (465 ft·lbf)	4.5 seconds	250 km/h (155 mph)

1.3Features

Mercedes-Benz has put all of its latest safety features into the CLS-class. In addition to front airbags, there are side-impact airbags in the front seats and side curtain airbags throughout. The car features a "smart" sensor system for the seatbelts and airbags that can detect and react to accident severity. An optional Pre-Safe system predicts an impending collision; when the system is activated, the seatbelts tighten, the front passenger seat adjusts to crash positioning, and the sunroof closes automatically. Mercedes-Benz engineers describe the feature as a human-like reflex system.

Figure (1.11)

2008 Mercedes-Benz CLS (Europe)

Figure (1.12)

2008 Mercedes-Benz CLS (Europe)

The air suspension has three settings. The default setting, "Comfort", is ideal under normal driving conditions, stiffening as the car's speed increases. "Sport 1" and "Sport 2" settings give the car more agility on winding and bumpy roads. The car can also be raised three inches (76 mm), if needed.

The CLS-class comes with a choice of four interior colors, three types of leather and two kinds of wood. Leather interior comes standard, with Nappa leather upholstery available on designo models. Burl walnut and dark laurel wood interior trim are available in either a high-gloss or silk matte finish. Leather colors include Black, Basalt Gray, Sunset Red and Cashmere. New scratch-resistant exterior paint is three times as durable as past exterior finishes.

There are 33 inches (838 mm) of rear legroom, which is not quite as accommodating as the 35.6 inches (904 mm) available in the E-Class. Elbow room is generous at 57 inches (1448 mm). The trunk can hold 16 cubic feet (453 L) of cargo.

The following features are standard in all models: heated auto-dimming mirrors, outside temperature gauge, rain-sensing wipers and projector-beam headlights. Also standard is a Thermatic automatic climate control system; this system assesses and adjusts interior temperature and humidity levels and filters the air in the cabin. There are dual controls in both the front and rear seats.

Other available features include: self-cleaning bi-xenon HID headlamps, distronic radar-guided cruise control, power sunroof, keyless go, drive authorization system and Parktronic parking sensors. Available electronics include: COMAND control system, GPS navigation and surround sound audio.

The CLS 55 AMG and CLS 63 AMG are modified versions of the CLS produced by Mercedes-AMG. Features exclusive to AMG models include: perforated sport seats, 18-inch (457 mm) light-alloy wheels with wider tires (for the UK), 19-inch five-spoke light-alloy wheels (standard in North America, optional for all other markets), large air inlets and quad chromed oval exhaust pipes.

Figure (1.13)

1.4Production and sales

German market share, E-Class vs. rivals

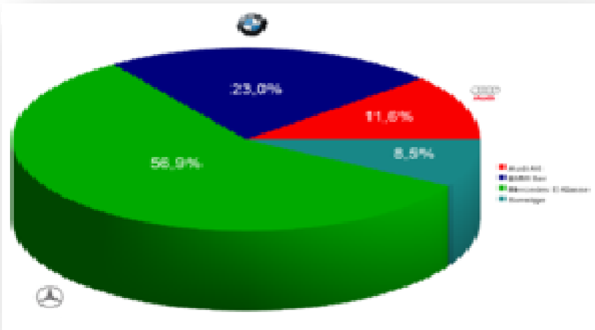

Figure (1.14)

Calendar year	Production (sedan/estate/coupe/convertible)	US sales	China sales
2001		44,445	
2002		42,598	
2003		55,683	
2004		58,954	

2005		50,383	
2006		50,195	
2007		48,950	
2008		38,576	
2009		43,072	8,200
2010	323,200 (208,400 / 44,400 / 49,600 / 20,800)	60,922	40,760

Chapter 2

seats and space

2.1 seats:

The 2012 Mercedes-Benz E-Class has no shortage of high-tech interior features, but critics say its simple, elegant design focuses on traditional luxury rather than electronic wizardry. The E-Class sedan's interior styling has a classic Mercedes feel, with sharp angles and quality materials throughout. Reviewers generally agree that the COMAND infotainment system has gotten more user-friendly, but comment that some controls, such as the awkwardly-placed cruise control stalk, aren't the most intuitive.

Arguably our most important passive safety feature, all four 3-point seat belts are equipped with Emergency Tensioning Devices (ETDs) and belt force limiters. If a collision exceeds a preset threshold, ETDs instantly remove slack from the seat belts. Belt force limiters allow a slight amount of give in the seat belts, to reduce the peak seat-belt forces on the occupant

Trim Package..

The designer of the wheel used ergonomics to design a wheel attractive and confort in driving

- **Wood/leather steering wheel**
- **Wood/ leather shift knob**
- **As left get keys used to change between the channel and select**
- **As right get keys which used to make and answer the call**

Figure (2.1)

Wheel multifunction

2.1.1 Seating ….

Leather upholstery

Supple, richly grained double-stitched leather is hand-fitted to the seating surfaces and head restraints

Figure (2.2)

Leather upholstery

Premium leather upgrade

Soft, top-stitched Premium leather is hand-fitted to the seat inserts, side bolsters and head restraints

Figure (2.3)

Premium leather

The E-Class sedan generally earns positive comments for its seats, which are highly adjustable and offer ample space for taller drivers. However, one critic notes that the optional dynamic front seats, which automatically adjust bolstering, feel intrusive on normal commutes. In the back, testers commend the E-Class for its spacious, comfortable accommodations.

Figure (2.4)

Back area

- **"In sedans, headroom and legroom are ample, even for taller or longerlegged drivers**
- **"The sedan's backseat is quite spacious, matching the BMW 5 Series as the most welcoming rear quarters in the midsize luxury class**

- **"Seat-shaped seat controls high on the door panels and seat heating/cooling controls at the very**
- **bottom of the center stack make it easy to adjust important things quickly**

Figure (2.5)

Socet of multimedia

- **In E350 seats the color is elegant, attractive, varies between black and beige and other color**
- **The shaping of the seats in model 2012 e350 confort and useful in driving**
- **The sofa in the second part of car can make closed to provide the area of the trunk**

Figure (2.6)

Area between two areas

Figure (2.7)

Front area

Figure (2.8)

Back area can closed as shown

2.2-way power front seats with memory

Intuitive, seat-shaped controls help you and your front passenger find your ideal seating positions with 14-way power adjustment, including a power lumbar support. A memory system for each front seat recalls three stored seat positions with the touch of a button. The driver-seat memory also includes the power steering column and side mirror positions.

Figure (2.9)

Seats control

Front sport seats with integrated NECK-PRO active head restraints

Designed to cradle the driver and front passenger through every curve, the deeply contoured front sport seats feature integrated head restraints with advanced NECK-PRO active technology

Figure (2.10)

Pro active head resistance

Interior Dimensions:

Front **Back**

35.5 inches

Headroom

Legroom	**32.6 inches**
Shoulder room	**48.9 inches**

Headroom	**36.8 inches**
Legroom	**42 inches**
Shoulder room	**54.1 inches**

Figure (2.11)

CARGO AREA

2.3 View

<u>Figure (2.12)</u>

<u>Figure (2.13)</u>

Cabin & Comfort

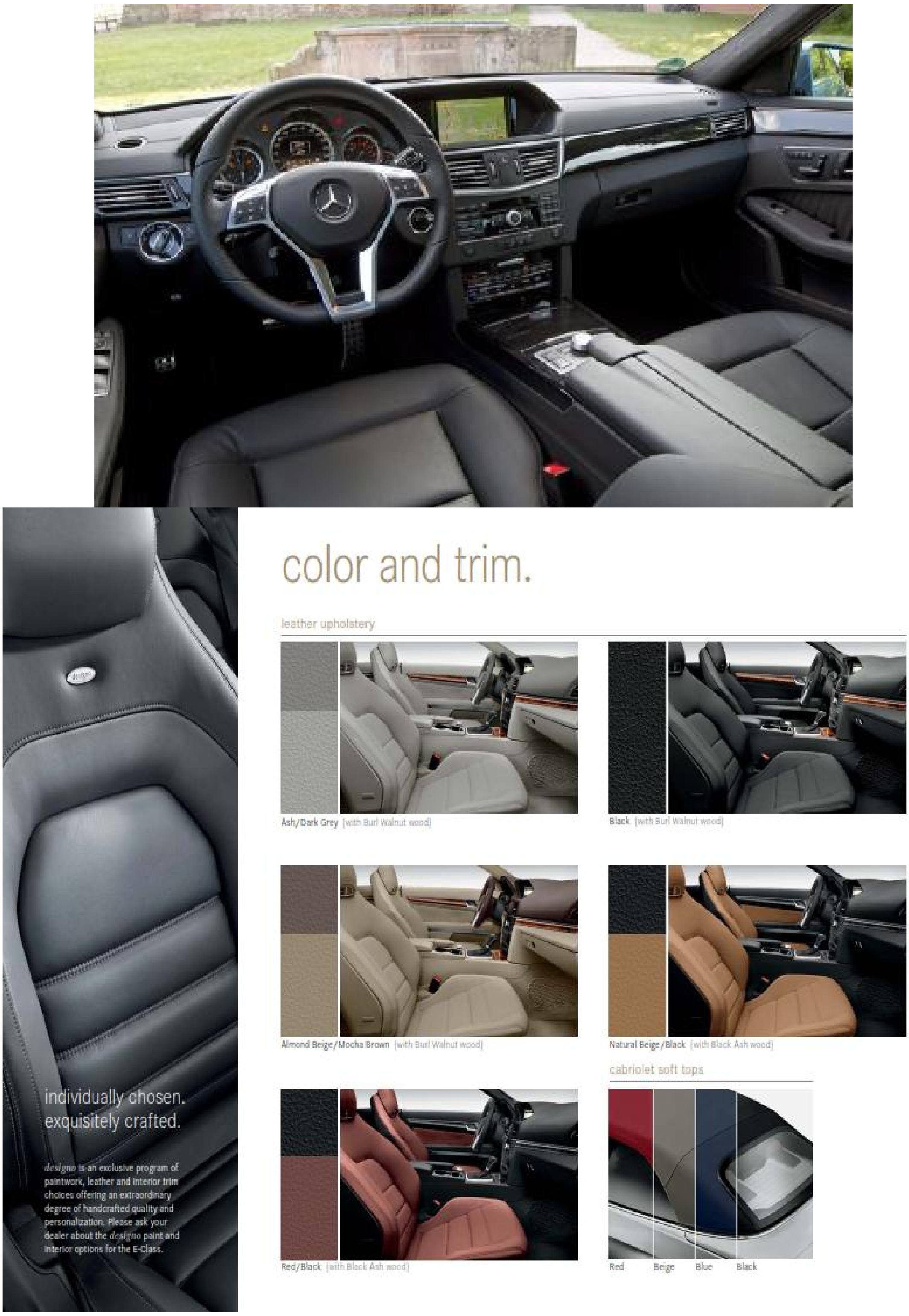

Figure (2.14)

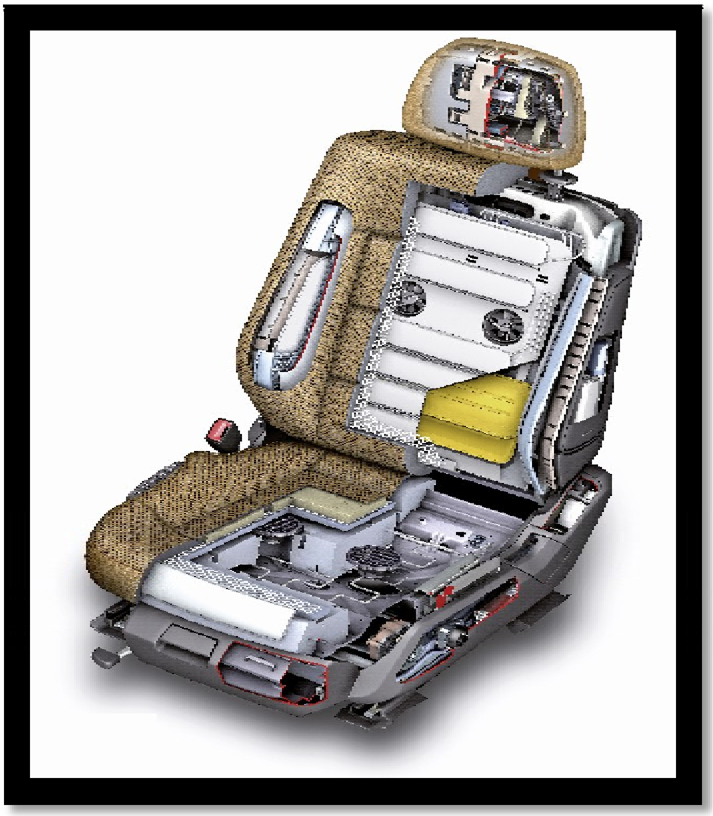

Figure (2.15)

Active Multicenter Seats

Figure (2.16)

Chapter 3

Dash Board and Tblon

3.1 What is a visual display?

A visual display is a device that presents information about objects, events or situations, to you through your eyes. Sometimes the display will be used in addition to information gained by observing the event or situation directly, but in some circumstances the display may be the only source of information available to you.

Examples include TV, your computer screen, thermometers, car instruments, charts, graphs, maps and other forms of printed or written material.

There are also displays that make use of your other senses:

Auditory - where information is presented to you via your ears. These displays are good at attracting your attention when vision can't be used (at night or with someone with limited sight, for example). Because of the ability of audio alarms to attract attention, they are often used to draw your attention to something (a car indicator clicking), and as emergency alarm systems (a fire alarm.(

Tactile - where information is presented to you via your sense of touch. The human tactile system is not as sensitive to differences or changes in stimulus as either the visual or auditory systems. An example of a tactile display is the Braille alphabet for the blind. The tactile sense can also tell you subtle information like temperature or surface condition (wet, sticky, slimy etc.) Have you ever felt a radiator to see if it is warming up؟

Some items can combine all three forms of display - your mobile phone is one example. You can read text messages from the screen, you can hear it ring and you can feel it vibrate.

3.2 Effective visual displays

Displays will generally be effective if they have

Good visibility - you can easily and clearly see the displays. To attract attention visually, the display must be within your field of vision and should flash or change in some other way. Humans are very good at detecting movement.

Good comprehension – you can make the correct decisions and control actions with minimum effort and delay, and with as few errors as possible, because you have understood the displayed information.

Good compatibility - the display can be used easily with others and you are not confused by any different types used. It can easily be seen and understood in the space and lighting in which it is used. The movement and layout of displays matches those of their controls.

3.2.1Types of display

Displays can be classified according to their physical characteristics (what they look like), or according to the type of information that they provide (what they are telling you

Classification according to physical characteristics

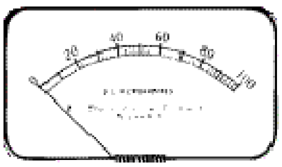

Figure (3.1)

DIALS

Dials have a graduated scale on which the indication of a value is shown by a pointer

INDICATORS

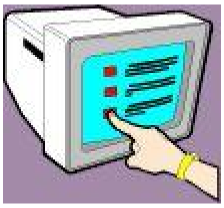

Figure (3.2)

These displays have no graduated scale, but display text or numeric information, or show the state of a system

WARNING DEVICES

Warning displays call for your attention and will require you to take some action, for example, a red traffic light means that you must stop your vehicle

COUNTERS

Figure (3.3)

Counters show information directly as numbers

3.3Classification according to type of information displayed

3.3.1QUANTITATIVE DISPLAYS

Quantitative displays show exact information. Digital quantitative displays present information directly as numbers, for example, the clock on your computer. Analogue quantitative displays can also be used where a length or angle represents the information, for example, a thermometer where the length of mercury or alcohol represents the temperature. The use of a particular quantitative display depends on

the kind of information that is required. If you need a precise reading, then digital indicators are most easily read.

3.3.2QUALITATIVE DISPLAYS

Qualitative displays give information about particular states, for example, hot or cold, alarm or no alarm. These displays can provide information about rate of change or direction of deviation from a desired value. These displays may include indicators and warning devices. They can be used in circumstances where you only need to know that a certain condition exists, for example, when the temperature is too hot or too cold, as in the case of an indicator light on an iron which goes out when the iron is up to temperature. The specific value is not needed, although that may be conveyed to you by other, quantitative visual displays.

Check-reading displays are a specific type of qualitative display in which you determine whether the value of a continuously changing variable is normal, or within an acceptably normal range, for example, car fuel gauges and tyre pressure gauges. Check-reading displays should have clearly distinguishable characteristics to identify the neutral or normal satisfactory condition, or the undesirable condition; perhaps green marking for an 'OK' level and red for 'out-of-limits.'

3.3.3REPRESENTATIONAL DISPLAYS

These displays can portray either working models or simplified diagrams of a complex process, system, or machine. They enable you to perceive the functioning of each part of the system or machine in correct relation to the whole system. London Underground and Ordnance Survey maps, and railway signal box mimic diagrams are examples of representational displays .

Representational displays should aim at schematic representation of information (keep it simple) rather than a complete representation or the actual representation.

The well-known London Underground map is an example of representing the geographic situation by a stylized and clearer design. The exact geographic inter-relationships of stations are

replaced by a color-coded series of lines which convey the structural layout of the system and make it easier for you to plan your route.

An ANALOGUE display generally shows a pointer and a scale. The position of the pointer on the scale continually corresponds to the value that the display represents.

A DIGITAL display shows information directly but as distinct values.

If rates and direction of change are needed then an analogue display may be more suitable than a digital display. If precise readings are needed quickly then a digital display may be better.

If something is QUANTITATIVE, it means that it is capable of being measured - it has a quantity. A quantitative display provides information about a value. For example, a quantitative speed reading would show that you are driving at 30 miles per hour.

If something is QUALITATIVE, it means that it is has a certain distinct feature - it has a quality. A qualitative display can provide information about the rate or direction of change, or about the state of a system (e.g. on or off). For example, a qualitative speed reading would show that you are slowing down or speeding up.

3.4 Design guidelines for displays

3.4.1Viewing distance

The maximum display viewing distance should be determined by the size of details shown on a display. The reading distance for displays is usually 300-750mm, as many displays have to be read at arm's length and must allow you to reach or adjust controls. Displays must be optimally positioned within your field of view.

3.4.2Illumination

Displays may have their own internal or back-lighting, but if not, their design should be suited to the lowest expected lighting level.

3.4.3Angle of view

The preferred angle of view for displays (the angle at which the display plane is positioned with regard to the person monitoring it) should be 90 degrees. This is especially important with large picture displays as positioning them at an angle may cause parts of the display to be hidden from your eyes.

3.4.4Combinations of displays

For these complex displays you will almost invariably have to divide attention between a number of tasks, as well as the displays themselves. Any inconsistencies in the manner of information-representation among the displays will be confusing, and will reduce your speed of reaction to a change indicated by a display, or even cause reading or decision errors. If a number of displays look alike, you may interpret data incorrectly. Each display should be easily distinguishable, and its information not easily confused with that on any other display.

3.4.5Compatibility with related controls

Displays and their associated controls should be designed and located so that you can select the correct control and operate it effectively and without error .

3.5 SPECIFIC GUIDELINES

3.5.1 Quantitative displays

The scale must be legible and you should avoid multiple or non-linear scales. Scale numbers, marking strokes, pointers, etc., should contrast well in tone and color with the display face. This should be combined with good illumination and the absence of glare or reflections. You should also position the dial near eye level and approximately at 90 degrees to your angle of view. Scale numbers should increase clockwise, left to right, or upward.

Legibility is the most important design factor. A simple rule of thumb which works well for average quality of lighting and eyesight and with sensible typefaces is the '1 to 200 rule'. Estimate where the display is to be read from, measure the distance from the eye to the display and divide by 200. You now have the height of the capital 'E' you need. So if a display is to be read from 5m then the letter height should be 5000/200mm = 25mm. If the distance is 400mm, as might be the case for a computer screen, then 2mm will work fine. This rule-of-thumb can also be used to establish the lettering size and the significant divisions for analogue displays.

Try this Create a document containing different sizes of random letters and numbers and print out. Hold this up towards the end of a corridor and see when people can accurately read what you are displaying. Don't forget to use some older people as their eyesight (even when 'corrected' with glasses or contact lenses) is not as good as yours! The reason for random letters is that we read and predict words and 'fill in' for anything that is not clear .

You should also note that people are not reliable in reading and remembering long strings of digits. Therefore you should limit a digital display to 6 or 7 numbers, and for repeated observation, to 4 numbers. Perception and memo ability of digits can also be enhanced by grouping them into pairs, leaving space between adjacent digits. (This 'chunking' of numbers helps you to remember your telephone number(.

3.5.2Qualitative Displays

Each of the displayed conditions should be as distinctive as possible, through differences in position, colour, shape or size on the display. You should integrate more than one of these means on the display, for example, by using lights combined with a change in position of the indicator. The fuel gauge in a car might, for example, flash when the tank is nearly empty. The different rings on an office phone for internal and external calls are another example of a qualitative alarm.

Straight, vertical dials are recommended for observing qualitative direction of change. Circular dials seems to be better for observing rate of change because the angle of the pointer will quickly tell you information about the rate of change.

If designing in a complex environment, such as a power station control room, you must make sure that only the minimum of audio warnings and alarms are triggered. Too many can be confusing and can increase the time taken to react to what could be a critical situation.

Figure (3.4)

3.6 Instrumentation of Mercedes e350 2012 as an example

TripComputerAnalog ClockSteering Wheel Mounted Controls For Audio, Instrumentation Display, Wireless Enabled Devices and TransmissionTire Pressure Monitor
3-Memory Adjustments For Driver Side Include Exterior Mirrors, Seat and Steering Wheel; Passenger Side Includes SeatTachometer
Voice Activated Controls For Bluetooth(R) Wireless Enabled Devices
Exterior Temperature GaugeService Interval Indicator
Cruise ControlCOMAND Centralized Control Instrumentation For Phone, Audio and Climate

Figure (3.5)

Figure (3.6)

The background is black numbers with Wight

The scale has a 3 numbers as maximum

From (20 km/h) to (260 km/h)

Figure (3.7)

3.7 Dashboard

At home comes the wheel sporty design purely signed the AMG with counters, telescopic great easy to read it while walking and offers the privacy of a great driver, and in the center comes screen data, which is controlled by the functions of the car from which the next to fit on

the navigation system developed can register any interface would like to go to them for removal is at any time while driving through a system of voice commands, and underneath the control system in the sound, which is simple to use heavy jobs as it contains a DVD player Bebel automatic drive with memory to carry more than 1000 songs and Bluetooth system to control the calls easily while driving voice-activated so as not to preoccupied with the driver from the road Working audio system with 8 speakers distributed carefully around the cabin to the availability of audio performance remarkable for the complement of the below buttons to control the air conditioning and that from which you can adjust the temperature for each of the driver or front passenger or passengers in the back of each individual with the ability to control the amount of air rushing which Complete that system seats is carefully designed to be a Sports Appearance convenient to use to provide the best use in any of the driving situations with livery skin naturally with a feel of a special inspires you in style and luxury unmatched with the control system to adjust the seats in front of 10 different movements, as well as the available car glass ceiling panoramic For more of a sense of comfort and widening

Figure (3.8)

Figure (3.9)

Chapter 4

Steering wheel

4.1Space, shape and color:

4.1.1Space

Among drivers who use safety belts, the possibility of a serious airbag inflation injury is cause for concern if there's less than 10 inches between the belted driver and the steering wheel. Most drivers, even short ones, normally sit with at least this much distance to the wheel. This is the finding of new Insurance Institute for Highway Safety research that measured the distance between the bottom of the breastbone and the steering wheel hub for 587 volunteers seated in their usual driving positions in their own vehicles.

Standardizing volunteers' heights and ages to the distribution of the adult population, researchers estimate that about 5 percent of women sit less than 10 inches from the steering wheel. Even among short women (5 foot-1/2 inch or shorter), two out of three still sit at least 10 inches away.

"Most drivers need only buckle up to avoid the risk of a serious airbag injury. Only a small proportion of belted drivers are potentially at risk," says Susan A. Ferguson, the Institute's research vice president who directed the study.

4.1.2Shape

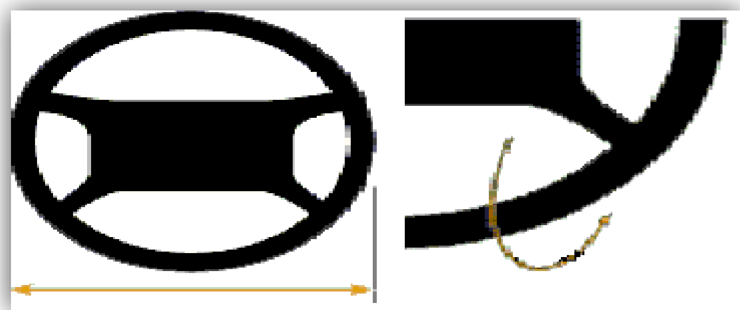

Figure (4.1): Outside diameter & Grip circumference

Size	Outside diameter	Grip circumference
Size A	15” - 16”	2 3/4” - 3 1/8”
Size AX	14 1/2” - 15 1/2”	3 1/4” - 3 1/2”
Size AXX	14 1/2” - 15 1/2”	3 5/8” - 3 7/8”
Size C	14 1/2” - 15 1/2”	3 7/8” - 4 1/4”
Size B	16 1/2” - 17 1/2”	2 3/4” - 3 1/8”
Size BX	16” - 17”	3 1/4” - 3 1/2”

4.1.3Color

Black is the color of authority and power, stability and strength. It is also the color associated with intelligence.

4.2 Standard:

Premium leather multifunction steering wheel

Wrapped in supple Premium leather, the E350 Sedan steering wheel includes power tilt and telescopic adjustment. For fingertip access to some of the vehicle functions you use most often, convenient buttons on the steering wheel let you control the audio volume and selection, send and end calls on your Bluetooth-enabled phone, and scroll through the features of the multifunction display in the instrument cluster.

Figure (4. 2): Premium leather multifunction steering wheel

4.3 Optional

4.3.1-spoke sport steering wheel

For maximum driving pleasure, the sport steering wheel features a grippy Premium leather-wrapped rim and sporty 3-spoke configuration. Raised thumb rests are placed at the ideal "10 and 2 o'clock" positions, while the racing-inspired flat-bottom design facilitates ingress and egress.

Figure (4.3): 3-spoke sport steering wheel

4.3.2 Wood steering wheel

Put a classic touch of luxury in your hands with a steering wheel accented with Black Ash or Burl Walnut wood to match the interior of the vehicle and trimmed in supple Premium leather.

Figure (4.4): Wood steering wheel

4.3.3 Heated steering wheel

Heating elements beneath the Premium leather trim of the steering wheel rapidly take the chill out of your hands on a cold morning

Figure (4.5): Heated steering wheel

Chapter 5

Motor and Suspension

5.1 VIEW of motor

Figure (5.1)

Figure (5.2)

Figure (5.3)

5.2 Suspension (vehicle)

Figure (5.4)

The front suspension components of a Ford Model T.

Figure (5.5)

The rear suspension on a truck: a leaf spring.

Figure (5.6)

Part of car front suspension and steering mechanism: tie rod, steering arm, king pin axis (using ball joints).

Figure (5.7)

Van Diemen RF01 Racing Car Suspension.

Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels. Suspension systems serve a dual purpose — contributing to the vehicle's roadholding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps, and vibrations,etc. These goals are generally at odds, so the tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different.

This article is primarily about four-wheeled (or more) vehicle suspension. For information on two-wheeled vehicles' suspensions see the motorcycle suspension, motorcycle fork, bicycle suspension, and bicycle fork articles.

5.2.1Damping

Damping is the control of motion or oscillation, as seen with the use of hydraulic gates and valves in a vehicles shock absorber. This may also vary, intentionally or unintentionally. Like spring rate, the optimal damping for comfort may be less than for control.

Damping controls the travel speed and resistance of the vehicle's suspension. An undamped car will oscillate up and down. With proper damping levels, the car will settle back to a normal state in a minimal amount of time. Most damping in modern vehicles can be controlled by increasing or decreasing the resistance to fluid flow in the shock absorber.

5.2.2Camber control

See dependent and independent below.

Camber changes due to wheel travel, body roll and suspension system deflection or compliance. In general, a tire wears and brakes best at -1 to -2° of camber from vertical. Depending on the tire and the road surface, it may hold the road best at a slightly different angle. Small changes in camber, front and rear, can be used to tune handling. Some race cars are tuned with -2–-7° camber depending on

the type of handling desired and the tire construction. Often, too much camber will result in the decrease of braking performance due to a reduced contact patch size through excessive camber variation in the suspension geometry. The amount of camber change in bump is determined by the instantaneous front view swing arm (FVSA) length of the suspension geometry, or in other words, the tendency of the tire to camber inward when compressed in bump.

5.2.3Roll center height

Roll center height is a product of suspension instant center heights and is a useful metric in analyzing weight transfer effects, body roll and front to rear roll stiffness distribution. Conventionally, roll stiffness distribution is tuned adjusting antiroll bars rather than roll center height (as both tend to have a similar effect on the sprung mass), but the height of the roll center is significant when considering the amount of jacking forces experienced.

5.2.4Instant center

Due to the fact that the wheel and tire's motion is constrained by the suspension links on the vehicle, the motion of the wheel package in the front view will scribe an imaginary arc in space with an "instantaneous center" of rotation at any given point along its path. The instant center for any wheel package can be found by following imaginary lines drawn through the suspension links to their intersection point.

A component of the tire's force vector points from the contact patch of the tire through instant center. The larger this component is, the less suspension motion will occur. Theoretically, if the resultant of the vertical load on the tire and the lateral force generated by it points directly into the instant center, the suspension links will not move. In this case, all weight transfer at that end of the vehicle will be geometric in nature. This is key information used in finding the force-based roll center as well.

In this respect the instant centers are more important to the handling of the vehicle than the kinematic roll center alone, in that the ratio of geometric to elastic weight transfer is determined by the forces at the tires and their directions in relation to the position of their respective instant centers.

5.2.5Anti-dive and anti-squat

Anti-dive and anti-squat are percentages and refer to the front diving under braking and the rear squatting under acceleration. They can be thought of as the counterparts for braking and acceleration as jacking forces are to cornering. The main reason for the difference is due to the different design goals between front and rear suspension, whereas suspension is usually symmetrical between the left and right of the vehicle.

The method of determining the anti-dive or anti-squat depends on whether the suspension linkages react to the torque of braking and accelerating. For example, with inboard brakes and half-shaft driven rear wheels, the suspension linkages do not, but with outboard brakes and a swing-axle driveline, they do.

To determine the percentage of front suspension braking anti-dive for outboard brakes, it is first necessary to determine the tangent of the angle between a line drawn, in side view, through the front tire patch and the front suspension instant center, and the horizontal. In addition, the percentage of braking effort at the front wheels must be known. Then, multiply the tangent by the front wheel braking effort percentage and divide by the ratio of the center of gravity height to the wheelbase. A value of 50% would mean that half of the weight transfer to the front wheels, during braking, is being transmitted through the front suspension linkage and half is being transmitted through the front suspension springs.

For inboard brakes, the same procedure is followed but using the wheel center instead of contact patch center.

Forward acceleration anti-squat is calculated in a similar manner and with the same relationship between percentage and weight transfer. Anti-squat values of 100% and more are commonly used in dragracing, but values of 50% or less are more common in cars which have to undergo severe braking. Higher values of anti-squat commonly cause wheel hop during braking. It is important to note that, while the value of 100%...in either case...means that all of the weight transfer is being carried through the suspension linkage, this does not mean that the suspension is incapable of carrying additional loads (aerodynamic, cornering, etc.) during an episode of braking or forward acceleration. In other words, no "binding" of the suspension is to be implied.

5.2.6Flexibility and vibration modes of the suspension elements

In modern cars, the flexibility is mainly in the rubber bushings. For high-stress suspensions, such as off-road vehicles, polyurethane bushings are available, which offer far more longevity under greater stresses.

5.2.7 Isolation from high frequency shock

For most purposes, the weight of the suspension components is unimportant, but at high frequencies, caused by road surface roughness, the parts isolated by rubber bushings act as a multistage filter to suppress noise and vibration better than can be done with only the tires and springs. (The springs work mainly in the vertical direction.)

5.2.8Contribution to unsprung weight and total weight

These are usually small, except that the suspension is related to whether the brakes and differential(s) are sprung.

5.2.9 Space occupied

Designs differ as to how much space they take up and where it is located. It is generally accepted that MacPherson struts are the most compact arrangement for front-engined vehicles, where space between the wheels is required to place the engine.

5.2.10Force distribution

The suspension attachment must match the frame design in geometry, strength and rigidity.

5.2.11Air resistance (drag)

Certain modern vehicles have height adjustable suspension in order to improve aerodynamics and fuel efficiency. And modern formula cars, that have exposed wheels and suspension, typically use streamlined tubing rather than simple round tubing for their suspension arms to reduce drag. Also typical is the use of rocker arm, push rod, or pull rod type suspensions, that among other things,

places the spring/damper unit inboard and out of the air stream to further reduce air resistance.

5.3 Springs and dampers

Most conventional suspensions use passive springs to absorb impacts and dampers (or shock absorbers) to control spring motions.

Some notable exceptions are the hydropneumatic systems, which can be treated as an integrated unit of gas spring and damping components, used by the French manufacturer Citroën and the hydrolastic, hydragas and rubber cone systems used by the British Motor Corporation, most notably on the Mini. A number of different types of each have been used:

5.3.1Passive suspensions

Traditional ssuspended in this manneprings and dampers are referred to as passive suspensions — most vehicles are r.

Figure (5.8)

Pneumatic spring on a semitrailer

Suspension geometry

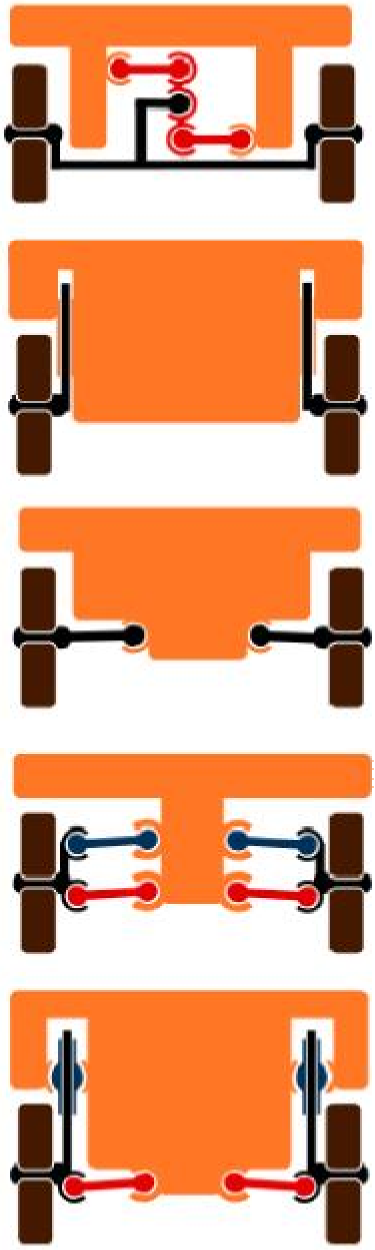

Figure (5.9)

Common types seen from behind; in order:

- **Live axle with Watt bar**
- **Suspension like on a bike fork**
- **Swing axle**

Double wishbone
MacPherson

This diagram is not exhaustive; notably excluding elements such as trailing arm links and those that are flexible.

5.4 Semi-independent suspension

In a semi-independent suspensions, the wheels of an axle are able to move relative to one another as in an independent suspension but the position of one wheel has an effect on the position and attitude of the other wheel. This effect is achieved via the twisting or deflecting of suspension parts under load. The most common type of semi-independent suspension is the twist beam.

The new Mercedes-Benz E-Class - PART X

WEDNESDAY, MARCH 04, 2009 ADRIAN-LIVIU DOROFTE **NO COMMENTS**

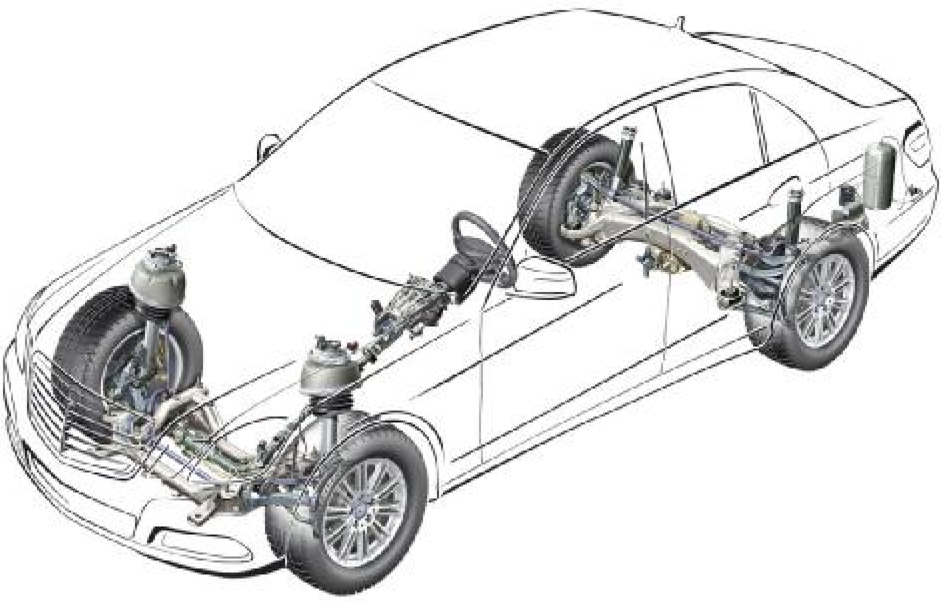

Figure (5.10)

OFFICIAL PRESS RELEASE

Front axle	E 200 CDI BlueEFFICIENCY, E 220 CDI BlueEFFICIENCY, E 200 CGI BlueEFFICIENCY	E 250 CDI BlueEFFICIENCY, E 350 CDI BlueEFFICIENCY, E 350 BlueTEC, E 250 CGI BlueFFICIENCY, E 350 CGI BlueEFFICIENCY	E 500
Brake calliper Brake disc Diameter Thickness	Single-piston sliding Internally ventilated 295 mm 28 mm	Single-piston sliding Internally ventilated 322 mm 32 mm	Four-piston sliding* Internally ventilated 344 mm 32 mm
Rear axle			
Brake calliper Brake disc Diameter Thickness	Single-piston sliding Solid 300 mm 10 mm	Single-piston sliding Internally ventilated 300 mm 22 mm (10 mm for E 250 CDI/ E 250 CGI)	Single-piston sliding Internally ventilated 320 mm 24 mm

*composite aluminium and nodular-cast-iron design

Figure (5.11)

MERCEDES-BENZAirSuspension Parts

CL-CLASS 2000-2006 (W215 w/ ABC Suspension)

Figure (5.12)

MERCEDES-BENZAir Suspension Parts

CLS-Class 2005-2011 (CLS55 AMG & CLS63 AMG)

Figure (5.13)

MERCEDES-BENZ
Air Suspension Parts

Figure (5.14)

CLS-Class 2005-2011 (W219 Chassis w/Airmatic only)

CLICK IMAGE TO ENLARG

MERCEDES-BENZAir Suspension Parts

Figure (5.15)

E-Class 2002-2009 (E55 AMG & E63 AMG)

MERCEDES-BENZAir Suspension Parts

Figure (5.16)

E-Class 2002-2009 (w211 w/airmatic & w/4matic)

CLICK IMAGE TO ENLARGE

MERCEDES-BENZAir Suspension Parts

Figure (5.17)

SL-CLASS 2007-2011 (SL550 & SL600) R230 chassis

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2009 mercedes benz

Figure (5.18)

Mercedes MB

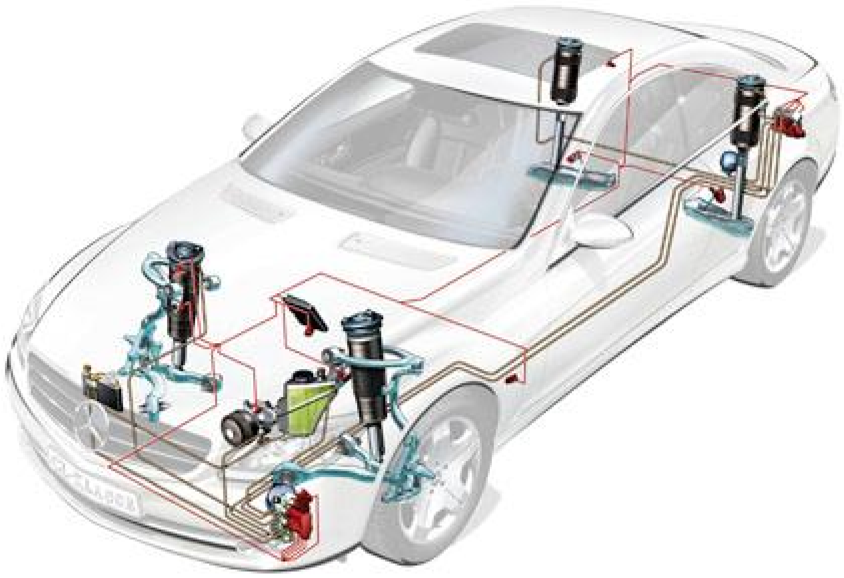
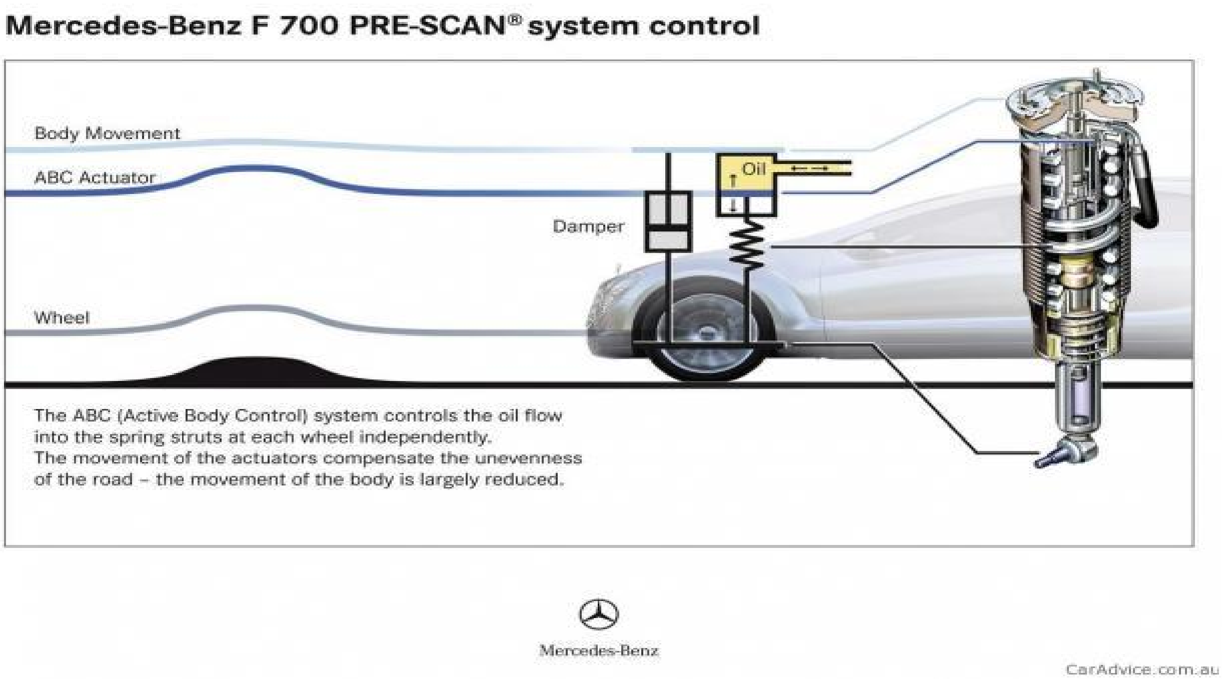


Figure (5.19)



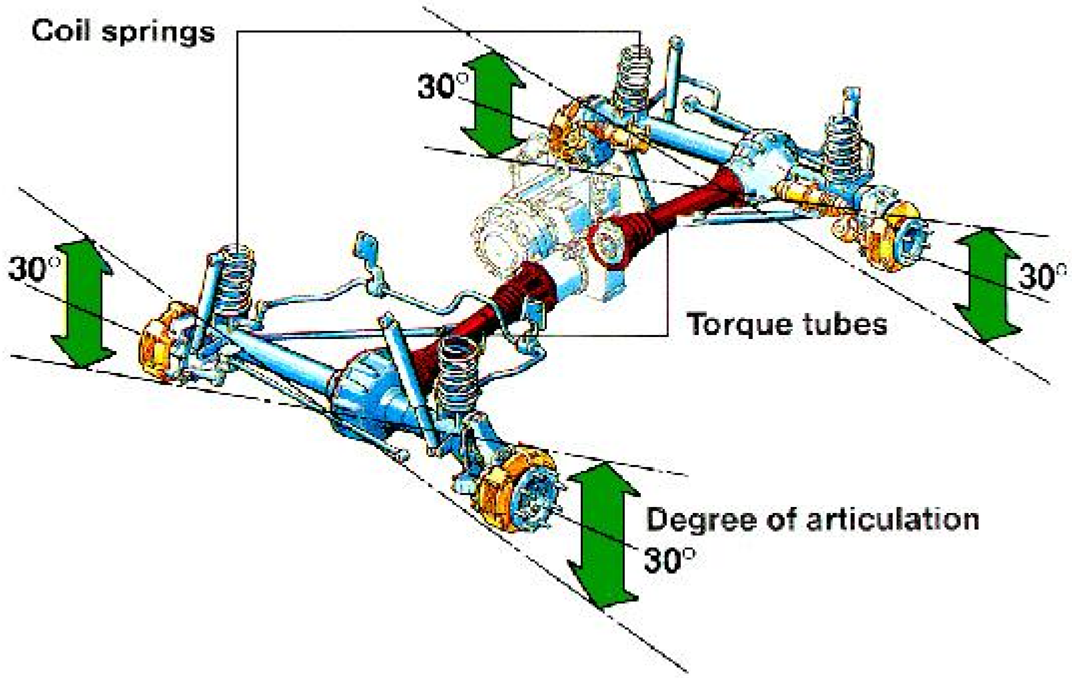
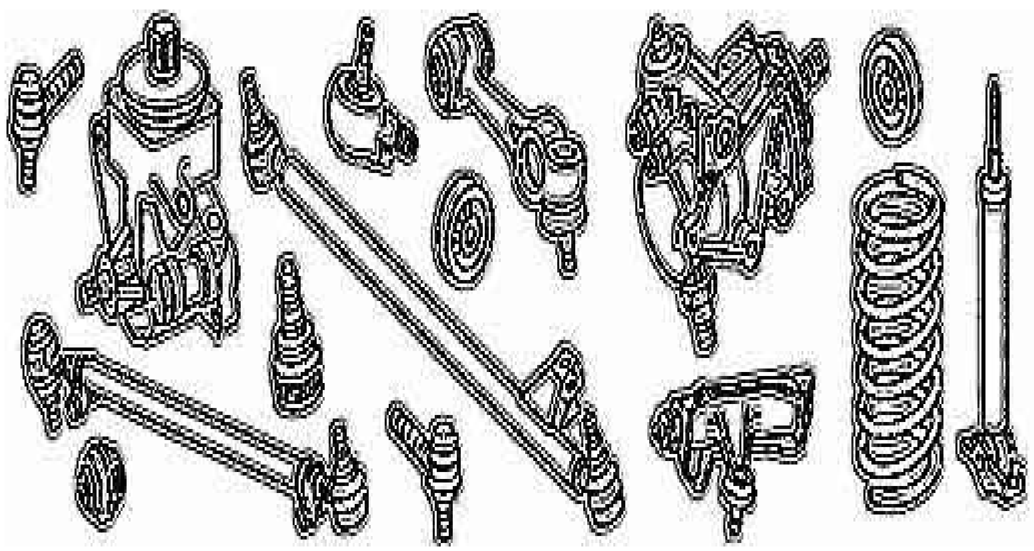
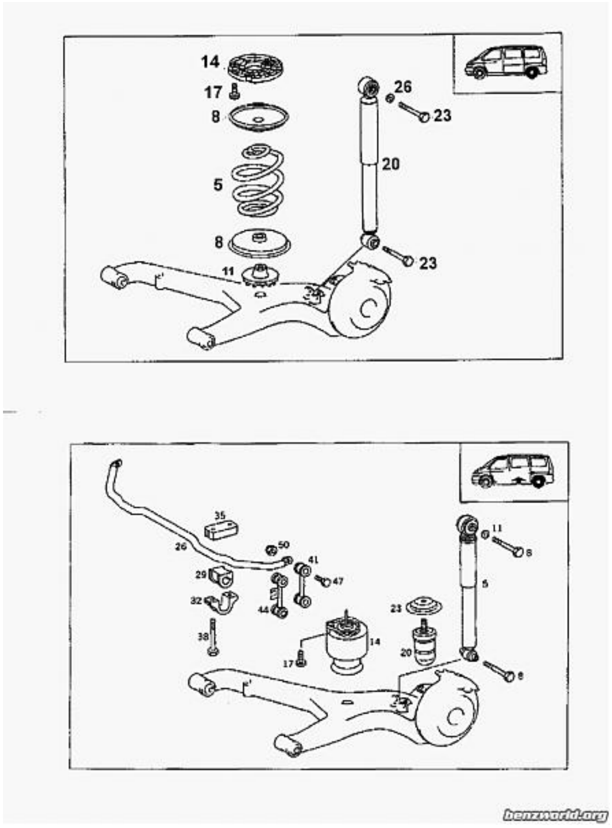


Figure (5.20)

5.5 SUSPENSION PARTS



Air suspension Mercedes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benzworld.org

Figure (5.21)

Chapter 6

Tires

6.1: Standard

Item description

This Michelin Primacy MXM4 tire shown in figure helps deliver a balance of sport handling and ride quality with energy efficient, all-season traction. You will enjoy every curve with the 2-D Active Sipes that create biting edges to help give you more confidence in rain or snow. In addition, this Michelin Primacy MXM4 uses computer-optimized design and precision manufacturing to offer greatly reduced vibrations and road noise.

Figure (6. 1): Michelin Primacy MXM4 Tire 245/45R17

Specifications

Treadwear Warranty	45,000 mi. / 55, 000 mi.
Tire Type	Passenger
Sidewall	Black Side Wall
Speed Rating	H
Load Index	99
Speed Rating Translation	130 mph
Load Index Translation	1709 lbs.
Shipping Weight (in pounds)	23.35
Product in Inches (L x W x H)	25.67 x 9.57 x 25.67

6.2: Optional

Item description

Goodyear Eagle GT-HR shown in figure Built extra tough with Race Wrap construction technology for great handling, precise response and an H-speed rating.

Features and Benefits

All-season tread: excellent year-round traction and low tread noise.

Race Wrap Construction Technology: helps provide toughness and H-speed rated performance.

Figure (6 - 2): Goodyear Eagle GT-HR Tire 245/45R17

Specifications

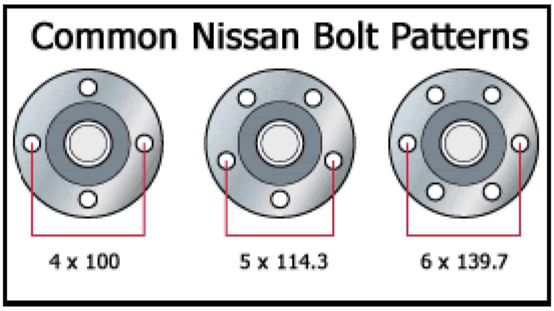
Treadwear Warranty	Y
Tire Type	Passenger-Highway
Side Wall	Black Wall
Speed Rating	H
Load Index	95
Speed Rating Translation	130 mph
Load Index Translation	1521 lbs.
Shipping Weight (in pounds)	24.71
Product in Inches (L x W x H)	26.02 x 26.02 x 26.02

6.3: Wheels

6.3.1: Overview

Bolt Pattern

The bolt pattern or bolt circle is an imaginary circular diameter formed by the centers of the wheel lugs. Nissan and Infiniti vehicles come with bolt patterns utilizing 4, 5, or 6 lug holes and they are relatively standardized. When looking to change the factory rims on your vehicle you will be asked what bolt pattern is utilized as not all automakers use the same patterns as your vehicle. As an example, the factory 4-lug 240sx bolt pattern is 4 x 114.3 whereas some Honda's use a 4 x 100.In this scenario, the rims are not interchangeable between vehicles. It should be noted that some aftermarket rim manufacturers do provide universal-fit rims which have elongated lug holes (or 8-10 holes which cover multiple bolt patterns) which will fit a wider-range of vehicles.



Figure(6- 3): Bolt Patterns

CenterBore

The center bore relates to the size of the hole in the center of the rim. When purchasing aftermarket rims, it is wise to ensure the center bore is the same diameter as that of the hub, this is termed as being hub-centric and ensures the rim is perfectly centered if the center bore is larger, you should purchase a hub-ring in order to ensure the rim is properly centered and hub-centric. Not utilizing a hub-ring means you are lug-centric and solely utilizing the lugs to center the wheels instead of the lugs and the hub. NOTE: The Center Bore for most Nissan Vehicles is 66.1

Backspace

Backspacing is the distance from the inside bolting surface (Hub mounting pad) of the rim to the outer edge of the inboard side of the rim. To determine backspacing simply lay the wheel face down and lay a straight edge (or board, or anything else that is flat) across the wheel. Use a tape measurer or ruler and measure the distance from the bottom of the straight edge to the hub mounting pad. This is your backspace and when choosing rims can help you determine rim depth in the wheel well.

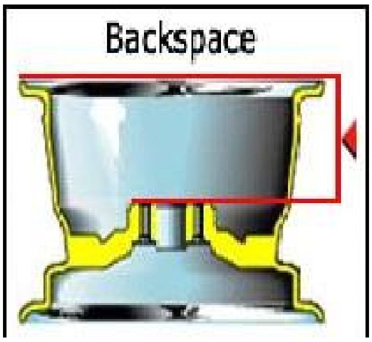


Figure (6- 4): Backspace

Offset

Offset is the distance from a wheels hub mounting surface to the center line of the wheel. There are three types of offset:

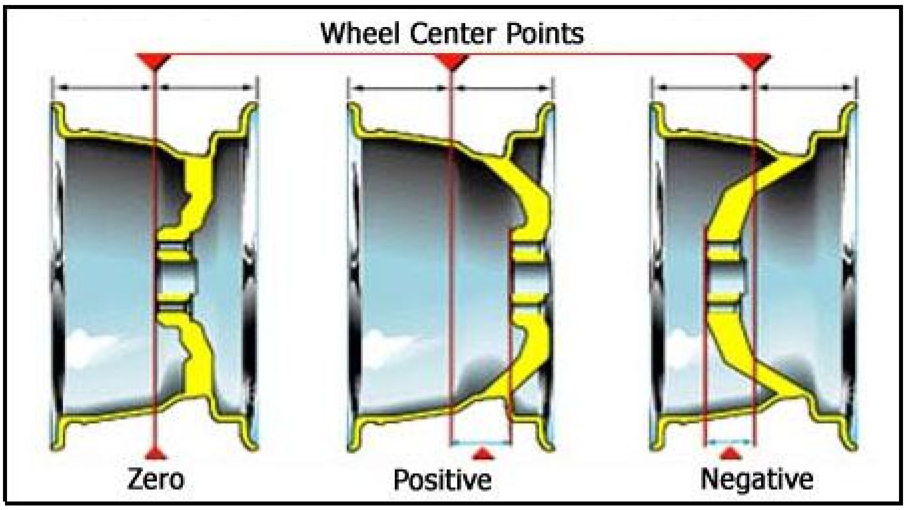


Figure (6- 5): Offset

Zero: The hub mounting surface is even with the center line of the rim.
Positive: The hub mounting surface is more towards the front and generally the style wheel used with FWD vehicles.
Negative: The hub mounting surface is toward the back side of the wheel's center line.

When considering new wheels, offset can make or break a decision. Using a rim with less offset can cause the tire/rim to rub the outer fender and using a rim with more offset can cause the tire/rim to rub the inner fender or even suspension components. As an example, consider the image to the left.

In the example, the factory rim utilizes a +45mm offset (the hub is +45mm from the center of the wheel) and the rim is centered within the wheel well.

Should new rims with a +30mm offset be utilized (the hub is +30mm from the center of the wheel), the edge of the rim is shifted further outbound by 15mm and closer to the fender lip. In some situations, this could cause the tire to rub the fender lip and in extreme cases can cause damage to the tire or fender itself. When utilizing a lowered suspension, there may be a greater chance of this issue.

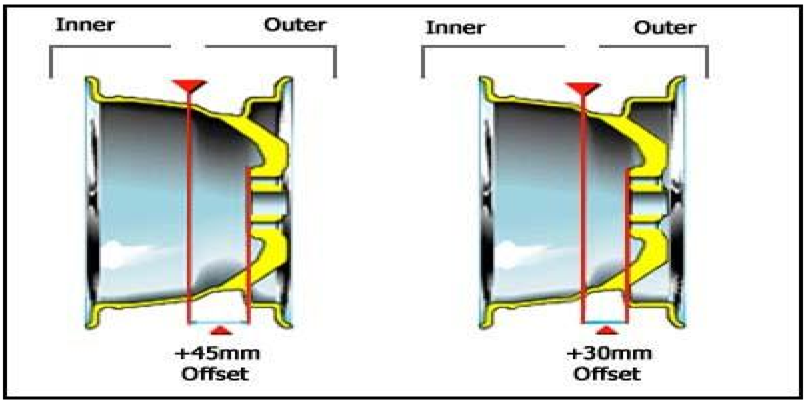


Figure (6- 6): rims with a +30mm offset utilized

Spacers

Some vehicle designs give the factory wheels a "sunk-in" look. An example of this is the Nissan Maxima, where the rear tires seem further in than the front tires. In order to get the rear tires to be more "flush" with the fender, some enthusiasts utilize wheel spacers. As shown to the left, utilizing wheel spacers can have a

similar effect as wheels with a lower offset. It should be noted that utilizing spacers will change the configuration from hub-centric to lug-centric and dependent on how wide the spacer is you may need to get longer (and higher strength) wheel studs.

Staggered

A staggered wheel setup is one in which the front wheels are a different diameter or utilize an offset that is dissimilar than the rear. Factory staggered wheel configurations can be found on RWD vehicles but not FWD. A staggered wheel setup on a RWD vehicle is usually utilized to allow the rear to have wider tires for more traction although some enthusiasts use a lower offset in the rear to achieve a more "deep dish" look to the rear wheels. Since FWD vehicles utilize front drive wheels, utilizing a staggered setup would be for looks only.

+1 Sizing

+1 sizing is when a larger wheel or tire is installed on the vehicle. If the factory rims are 15″ then +1 sizing would be 16″ rims (+2 = 17″, +3 = 18″, etc).Realize that utilizing +1 sizing you should consult the tire shop in order to use the proper sized tire to keep the speedometer as close to factory calibration as possible.

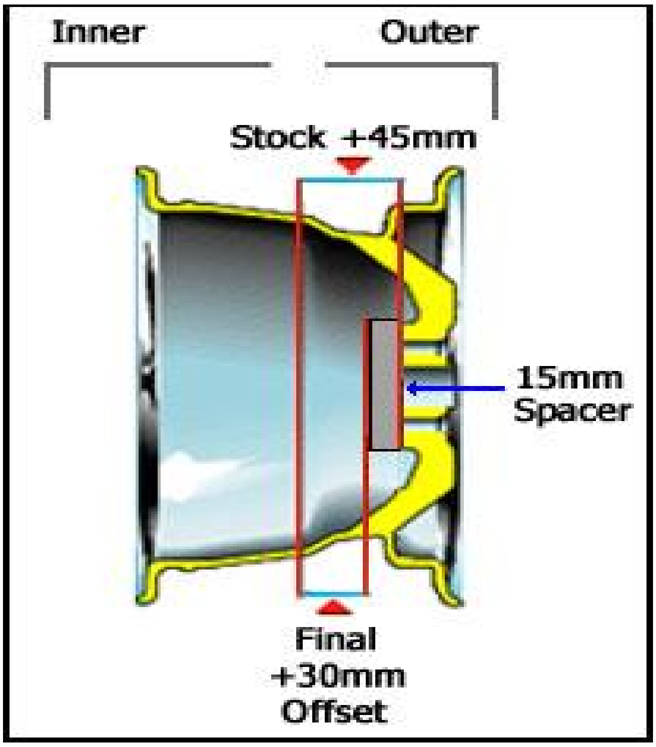


Figure (6- 7): Spacer

6.3.2: Standard

17-inch 8-spoke alloy wheels

Intricate yet elegant new 8-spoke 17-inch alloy wheels are standard on the E350 Luxury Wagon. They come fitted with all-season tires.

Figure (6- 8): 17-inch 8-spoke alloy wheels

Front axle: 8.5 J x 17", tire size: 245/45 R 17
Rear axle: 8.5 J x 17", tire size: 245/45 R 17

17-inch 5-spoke light-alloy wheels

For bold styling with the added ride comfort, sporty 17-inch alloy wheels with a dynamic new 5-spoke design are available at no charge on the E350 Sport Sedan. They come fitted with all-season tires.

Figure (6- 9): 17-inch 5-spoke light-alloy wheels

Front axle: 8 J x 16", tire size 225/55 R 16 Rear axle: 8 J x 16", tire size: 225/55 R 16[6]

Front axle: 8.5 J x 17", tire size: 245/45 R 17 Rear axle: 8.5 J x 17", tire size: 245/45 R 17

Chapter 7

Mercedes Benz E350 exterior

7.1Car exterior and aerodynamics:

General Aerodynamic Principals:

- **Drag:**

A simple definition of aerodynamics is the study of the flow of air around and through a vehicle, primarily if it is in motion. To understand this flow, you can visualize a car moving through the air. As we all know, it takes some energy to move the car through the air, and this energy is used to overcome a force called Drag.

Drag, in vehicle aerodynamics, is comprised primarily of two forces. Frontal pressure is caused by the air attempting to flow around the front of the car. As millions of air molecules approach the front grill of the car, they begin to compress, and in doing so raise the air pressure in front of the car. At the same time, the air molecules traveling along the sides of the car are at atmospheric pressure, a lower pressure compared to the molecules at the front of the car.

Just like an air tank, if the valve to the lower pressure atmosphere outside the tank is opened, the air molecules will naturally flow to the lower pressure area, eventually equalizing the pressure inside and outside the tank. The same rules apply to cars. The compressed molecules of air naturally seek a way out of the high pressure zone in front of the car, and they find it around the sides, top and bottom of the car. See the diagram below. Fig (7.1)

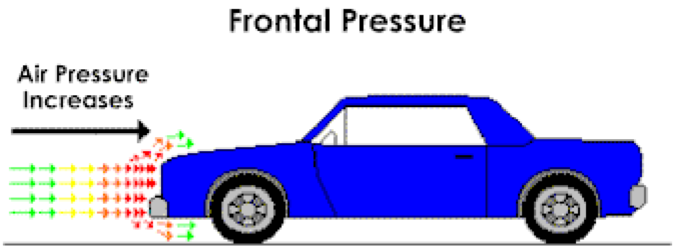


Figure (7.1) effect of frontal pressure

Rear vacuum (a non-technical term, but very descriptive) is caused by the "hole" left in the air as the car passes through it. To visualize this, imagine a bus driving down a road. The blocky shape of the bus punches a big hole in the air, with the air rushing around the body, as mentioned above. At speeds above a crawl, the space directly behind the bus is "empty" or like a vacuum. This empty area is a result of the air molecules not being able to fill the hole as quickly as the bus can make it. The air molecules attempt to fill in to this area, but the bus is always one step ahead, and as a result, a continuous vacuum sucks in the opposite direction of the bus. This inability to fill the hole left by the bus is technically called Flow detachment. See the diagram below .fig(7.2)

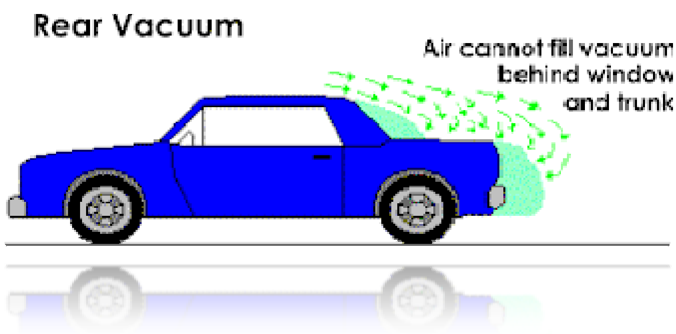


Figure (7.2) effect of rear vacuum

- **Lift (or Down force)**

One term very often heard in race car circles is down force. Down force is the same as the lift experienced by airplane wings, only it acts to press down, instead of lifting up. Every object traveling through air creates either a lifting or down force situation. Race cars, of course use things like inverted wings to force the car down onto the track, increasing traction. The average street car however tends to create lift. This is because the car body shape itself generates a low pressure area above itself.

How does a car generate this low pressure area? According to Bernoulli, the man who defined the basic rules of fluid dynamics, for a given volume of air, the higher the speed the air molecules are traveling, the lower the pressure becomes. Likewise, for a given volume of air, the lower the speed of the air molecules, the higher the pressure becomes. This of course only applies to air in motion across a still body, or to a vehicle in motion, moving through still air.

When we discussed Frontal Pressure, above, we said that the air pressure was high as the air rammed into the front grill of the car. What is really happening is that the air slows down as it approaches the front of the car, and as a result more molecules are packed into a smaller space. Once the air stagnates at the point in front of the car, it seeks a lower pressure area, such as the sides, top and bottom of the car.

Now, as the air flows over the hood of the car, it's loses pressure, but when it reaches the windscreen, it again comes up against a barrier, and briefly reaches a higher pressure. The lower pressure area above the hood of the car creates a small lifting force that acts upon the area of the hood (Sort of like trying to suck the hood off the car). The higher pressure area in front of the windscreen creates a small (or not so small) down force. This is akin to pressing down on the windshield.

Where most road cars get into trouble is the fact that there is a large surface area on top of the car's roof. As the higher pressure air in front of the wind screen travels over the windscreen, it accelerates, causing the pressure to drop. This lower pressure literally lifts on the car's roof as the air passes over it. Worse still, once the air makes it's way to the rear window, the notch created by the window dropping down to the trunk leaves a vacuum, or low pressure space that the air is not able to fill properly. The flow is said to detach and the resulting lower pressure creates lift that then acts upon the surface area of the trunk. This can be seen in old 1950's racing sedans, where the driver would feel the car becoming "light" in the rear when traveling at high speeds. See the diagram below.fig (7.3)

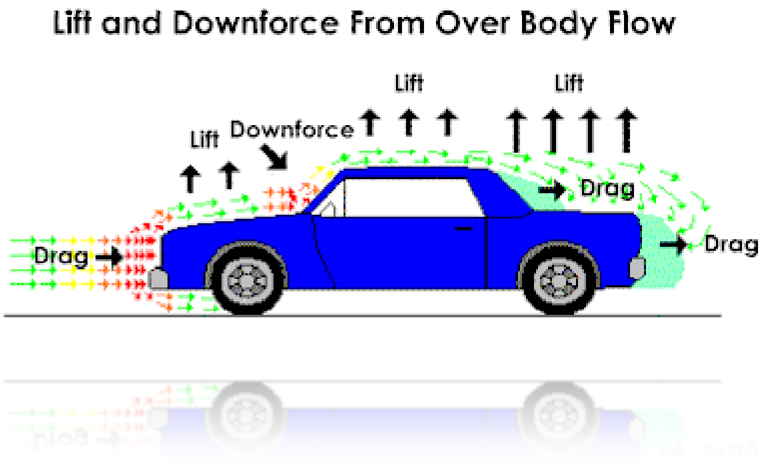


Figure (7.3) the forces effecting on the car exterior

Not to be forgotten, the underside of the car is also responsible for creating lift or down force. If a car's front end is lower than the rear end, then the widening gap between the underside and the road creates a vacuum or low pressure area, and therefore "suction" that equates to down force. The lower front of the car effectively restricts the air flow under the car. See the diagram below.fig (1.4)

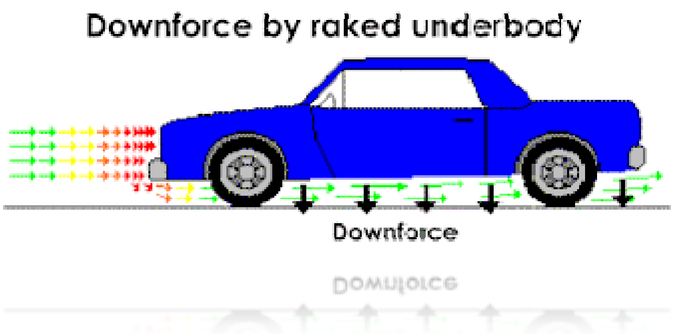


Figure (7.4) effect of down force

- **Drag Coefficient**

The shape of a car, as the aerodynamic theory above suggests, is largely responsible for how much drag the car has. Ideally, the car body should:

- Have a small grill, to minimize frontal pressure.
- Have minimal ground clearance below the grill, to minimize air flow under the car.
- Have a steeply raked windshield to avoid pressure build up in front.
- Have a "Fastback" style rear window and deck, to permit the air flow to stay attached.
- Have a converging "Tail" to keep the air flow attached.
- Have a slightly raked underside, to create low pressure under the car, in concert with the fact that the minimal ground clearance mentioned above allows even less air flow under the car.

What all these "ideal" attributes stack up to is called the Drag coefficient (Cd). The best road cars today manage a Cd of about 0.28. Formula 1 cars, with their wings and open wheels (a massive drag component) manage a minimum of about 0.75.

Aerodynamic Devices:

- **Spoilers:**

Spoilers are used primarily on sedan-type race cars. They act like barriers to air flow, in order to build up higher air pressure in front of the spoiler. This is useful, because as mentioned previously, a sedan car tends to become "Light" in the rear end as the low pressure area above the trunk lifts the rear end of the car. See the diagram below: fig(7.5)

Figure (7.5) effect of using the spoiler

- **Wings:**

Probably the most popular form of aerodynamic aid is the wing. Wings perform very efficiently, generating lots of down force for a small penalty in drag. Spoiler is not nearly as efficient, but because of their practicality and simplicity, spoilers are used a lot on sedans.

The wing works by differentiating pressure on the top and bottom surface of the wing. As mentioned previously, the higher the speed of a given volume of air, the lower the pressure of that air, and vice-versa. What a wing does is make the air passing under it travel a larger distance than the air passing over it (in race car applications). Because air molecules approaching the leading edge of the wing are forced to separate, some going over the top of the wing, and some going under the bottom, they are forced to travel differing distances in order to "Meet up" again at the trailing edge of the wing. This is part of Bernoulli's theory.

What happens is that the lower pressure area under the wing allows the higher pressure area above the wing to "push" down on the wing, and hence the car it's mounted to. See the diagram below: fig (7.6)

Figure (7.6) wings

7.2 The exterior material:

Mercedes-Benz has a long history of combining quality materials and cutting edge technology to build its cars. Strong, light-weight materials are used to craft body components and structural elements which could be made from carbon fibers,

The body structure of Mercedes Benz E350:

Containing 72% of its body panels made from high-strength steel, the E-Class body structure is even more rigid than its renowned predecessors. The advanced front crumple zone has been refined with approximately 17,000 computer-simulated collisions and 150 crash tests. An innovative front bulkhead and deformation zones that act on four independent levels to help divert the energy of a frontal impact under, over and around the passenger cabin. See fig (7.7)

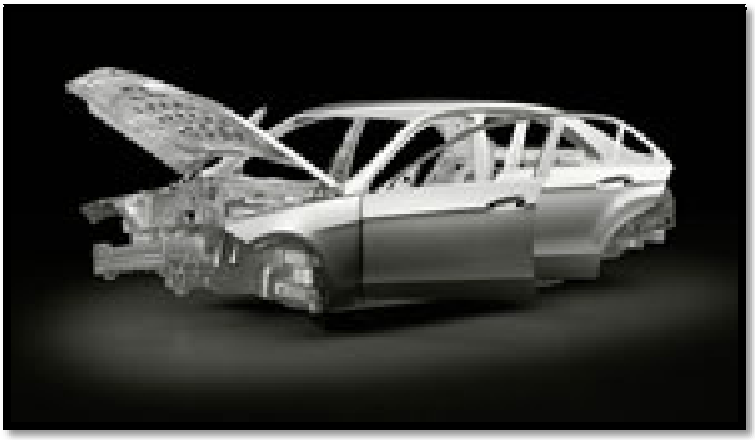


Figure (7.7) E-class body structure

7.3Mercedes Benz E-class E350 exterior:

From the beginning of the E350 until 2009 there was no changing in the exterior but at 2010 Mercedes Benz showed up a new streamlined exterior design 25% by different body lines and colors, they also replaced the rounding headlights with a new one which is taken from the art of cubes and squares, the exterior design of 2012 e350 exterior is more streamlined than the last one which helps on saving the fuel.

- ### 2012 E350:

-From 2010 until 2012 the exterior does not changed but some new models are added such as coupes, cabriolet.

Ø E350 sedan:

With a modern interpretation of design cues made iconic by its legendary predecessors, the E-Class Sedans “4 doors” deliver style that's both timeless and trendsetting. Bold lines stretch from the chiseled, arrow-shaped hood; classical chrome and signature four-lamp face to the sculpted rear quarters whose contours pay homage to the classic "Pontoon" Mercedes of the 1950s.as shown in fig (7.8).

Figure (7.8) the back view of 2012 E350 sedan

-this time the back view mirrors is much better and also with a new technology that helps the driver , Above approximately 20 mph, Active Blind Spot Assist can alert you to some unseen vehicles in the next lane. If radar sensors in the rear bumper detect a vehicle in the "blind spot" area to either side, an indicator lights up in the appropriate side mirror. If you activate a turn signal while a vehicle is detected, a warning sounds. And if you disregard the alerts and begin changing lanes, advanced active technology can apply the brake to a single rear wheel, to help guide the car back into its lane. As shown at fig (7.9)

Figure (7.9) back view mirrors of 2012 E350 sedan

Door hand holders:

This is the same hand holder of all Mercedes Benz E-class.

Figure (7.10) door hand holder of 2012 E350

Sliding sun roof:

At the touch of a button, the tinted glass sunroof tilts up at the rear for ventilation, or slides open for a breezy view of the sky. An express feature fully opens or closes the roof with a single touch, and a manual sliding sunshade helps block out unwanted sunlight. See fig (7.11).

Figure (7.11) sliding roof of 2012 E350 sedan

Exterior dimension:

Overall length	**191.7 inches**
Overall height	**57.9 inches**
Overall width	**81.5 inches (with mirrors)** **73.0 inches (without mirrors)**
Wheelbase	**113.2 inches**
Coefficient of drag	**0.27**
Curb weight	**3,825 lbs**

Fig (7.12) dimension of 2012 E350 exterior

Ø E350 coupes:

The coupes car the same exterior features of the sedan but this time with 2 doors and different roof design .see fig (7.13)

Figure(7.13) 2012 E350 coupes

Figure (7.14) 2012 E350 coupes

Panorama roof:

Offering both front- and rear-seat passengers sweeping skyward views, this fully functional glass sunroof features a front panel that can either tilt up for ventilation or slide over the rear panel for an open-air feeling. Dual interior power shades allow occupants to adjust the amount of sunlight entering the cabin.

Figure (7.15) panorama roof of E350 coupes

Exterior dimension:

Wheelbase	108.7 inches
Overall length	185 inches
Overall height	54.8 inches
Overall width	79.3 inches w mirrors 70.3 inches w/o mirrors
Coefficient of drag	.27 Cd
Curb weight	3,619 lbs.

Figure (7.16) 2012 e350 coupes exterior dimension

- E 350 cabriolet:

The same as the coupe with sportive look, 2doors but this time with a removal roof.

Figure (7.17) 2012 E350 cabriolet

Roof:

All season's sound dampening soft top, with its three layers totaling nearly an inch of thickness, the E-Class Cabriolet soft top is meticulously crafted for long-lasting beauty and a remarkably quiet cabin. At the touch of a button, it disappears from sight but leaves more usable trunk and cabin space than competitors' folding hardtops.

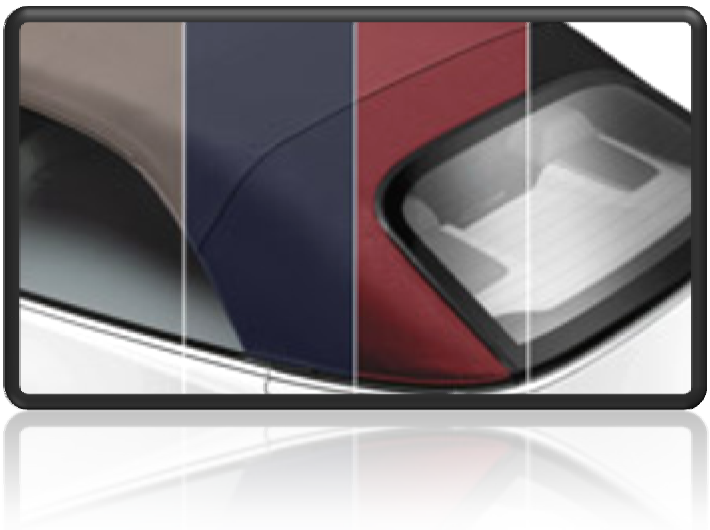


Figure (7.18) removable roof of 2012 E350 cabriolet

Figure (7.19) 2012 E350 cabriolet

Exterior dimension:

Wheelbase	**108.7 inches**
Overall length	**185 inches**
Overall height	**55 inches**
Overall width	**79.3 inches w mirrors 70.3 inches w/o mirrors**
EDR	
Coefficient of drag	**.29 Cd**
Curb weight	**3,883 lbs**

Figure (7.20) exterior dimension of 2012 E350 cabriolet

- E350 wagon:

The family form of the sedan with 5doors, the trunk is replaced by a saloon the roof is changed to be a panorama roof.

Figure (7.21) 2012 E350 wagon

Figure (7.22) 2012 E350 wagon

Panorama roof:

Offering both front- and rear-seat passengers sweeping skyward views, this fully functional glass sunroof features a front panel that can either tilt up for ventilation or slide over the rear panel for an open-air feeling. Dual interior power shades allow occupants to adjust the amount of sunlight entering the cabin. See fig (7.23).

Figure (7.23) panorama roof of 2012 E350 wagon

Figure (7.24) upper view of panorama roof

Roof spoiler:

This roof spoiler extends the roofline of your E-Class enhancing its sporty appearance. Tailor-made of high-quality material for quick installation and a perfect fit. Comes primed, ready for painting. See Fig (7.25).

Figure (7.25) roof spoiler of 2012 E350 wagon

Exterior dimension:

Wheelbase	**113.2 inches**
Overall length	**192.7 inches**
Overall height	**58.9 inches**
Overall width	**81.5 inches (with mirrors)** **73.0 inches (without mirrors)**
Coefficient of drag	**0.3**
Curb weight	**4,213 lbs**

Fig (7.26) exterior dimensions of 2012 E350 wagon

7.4 Mercedes Benz E350 headlights taillights:

Figure (7.27) headlight of E350:

- LED Daytime Running Lamps

Bright white LED Daytime Running Lamps help increase the visibility of your vehicle to oncoming traffic by illuminating front lights whenever the car is switched on. With long life and low energy consumption, the light-emitting diode (LED) lamps also add a distinctive high-tech styling touch. See fig (7.28)

Figure (7.28) daytime running lamp

- Bi-Xenon headlamps with Active Curve Illumination:

Bi-Xenon headlamps help deliver greater visibility than halogen headlamps because their brighter, whiter light is much closer to natural daylight. Active Curve Illumination helps you see better into corners at night, swiveling the headlamps as you steer to increase usable illumination by up to 90% over conventional fixed headlamps. See fig (7.29)

Fig (7.29) headlights of 2012 E350

Fig (7.30) angle view of E350 headlights

Taillights:

- LED tail lamps

Not only brighter than traditional incandescent bulbs, LED technology also delivers quicker illumination of the brake lamps. By offering drivers behind you more time to react, their stopping distance may be reduced by several feet, which could make a critical difference in a panic stop.

Figure (7.31) Mercedes E350 taillights

7.5Car exterior paint and color code:

The paint colors is the same in every region but there is some difference between the property of paint from region to another which depends on the climate of this region whether it is hot, cold, sunny, cloudy Rainy or snowy, this must be taken in consideration so that the paint will handle all the condition's and would not be damaged.

Each color has a code this code is changing from a make to another for example the black color has a color code in BMW and another at Mercedes.

The Mercedes new color collection for 2012 models is shown in fig (7.32)

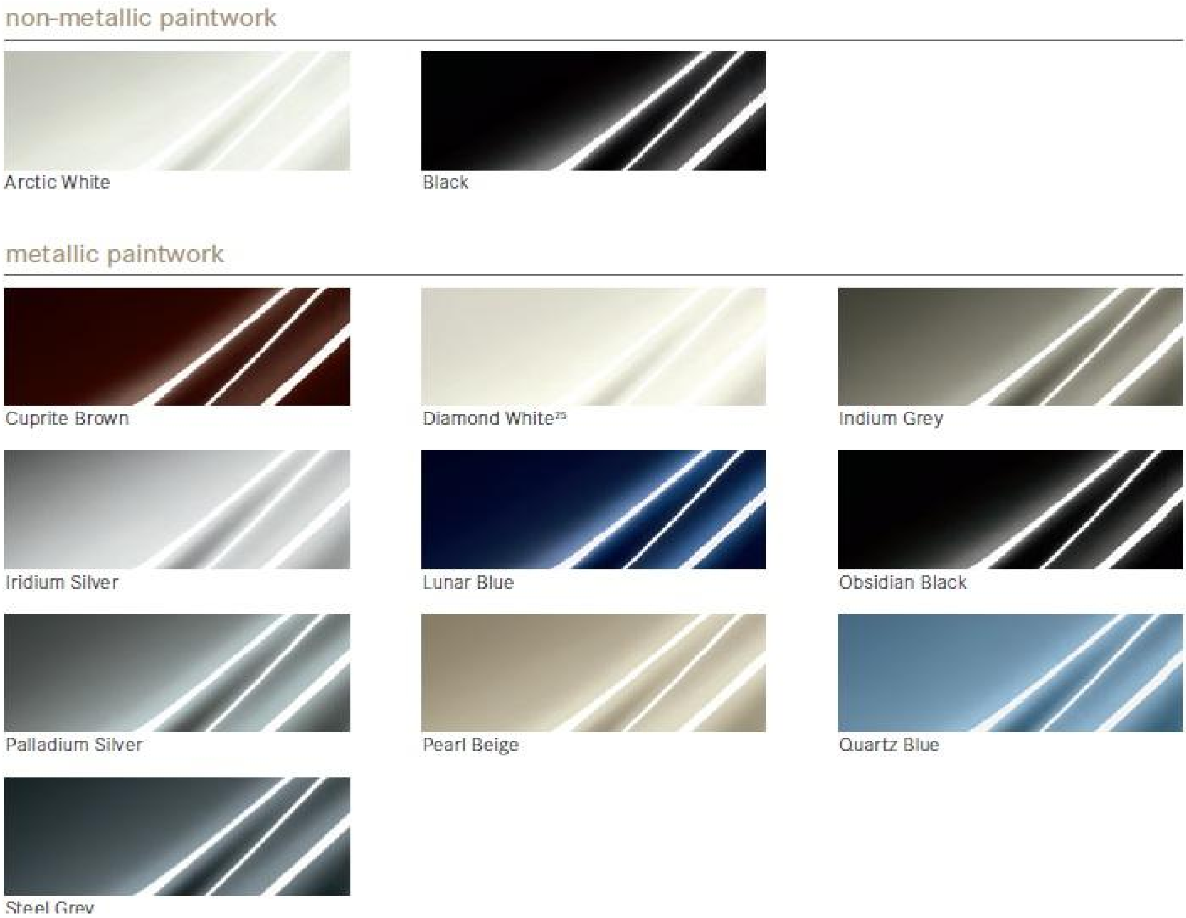


Figure (7.32) color collections of E350 models 2012

Figure (7.33)2012 E350 sedan in lunar blue

Figure (7.34) 2012 E350 cuprites brown

Fig (7.35) E350 cabriolet in steel gray

Summary

That is the life cycle of stars generation followed generation with more sparkle and global, creative design, Stars begin creator did not see the likes of before and ends up to be the seed success poses new stars we see them as the future of the car east and the remind us always you were stars past creativity will never forget, since it began Mercedes-Benz in its name, E350 cars on an average size in the eighties and that class does not mean only every estimate and luxury and distinction to the category of the Ultimate is always worth the attention of the Mercedes-Benz

First version was the Cuban E350 Shopping under the name of CLK for the followers of the policy of Mercedes Benz in separately each category Pfla and symbol of your even changed the company's policy this year to make the group the Cuban closer to being for the E350 the heart and mind and to complement the new idea on behalf of E350Coupe.

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References

***http://www.mbusa.com/mercedes/vehicles/model/class-E/model-E350W#design**

http://autopedia.com/html/Airbag/HwySafetyOrg.html*

***http://www.studebakerparts.com/studebakerparts/store/s/agora.cgi?page=swheelcvr.html**

***http://www.precisionintermedia.com/color.html**

***http://www.walmart.com/catalog/tiresAction.do?cat=91085&tire**

***http://www.nicoclub.com/archives/wheel-tech.html**
***www.MERCEDES-BENZ.com**

***WWW.mbusa.com**

***www.autoblog.com**

***Mercedes Benz official web site**

***Mercedes Benz E350 2012 broacher**